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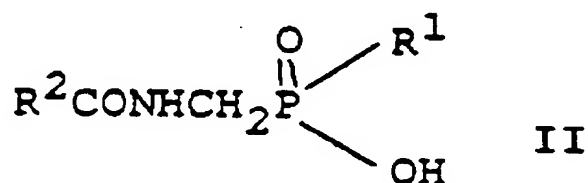
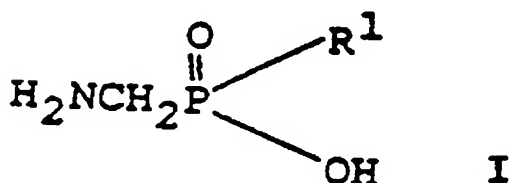
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(54) Titre : METHODE DE PREPARATION D'ACIDE AMINOMETHANEPHOSPHONIQUE ET D'ACIDES
AMINOMETHYLPHOSPHINIQUE

(54) Title: PROCESS FOR THE PREPARATION OF AMINOMETHANEPHOSPHONIC ACID AND
AMINOMETHYLPHOSPHINIC ACIDS



(57) Abrégé/Abstract:

Aminomethanephosphonic acid and aminomethylphosphinic acids are interesting as biologically active compounds or as intermediates for the preparation of biologically active compounds. According to the invention, such compounds of the formula I (see formula I) in which R¹ is OH, C₁-C₄-alkyl or phenyl, can be prepared in a technically simple manner by reacting compounds of formula II (see formula II) in which R² is H, C₁-C₆-alkyl, benzyl, phenyl, optionally substituted by C₁-C₄-alkyl, -alkoxy and/or halogen, and R¹ is defined above, with water, at 80 to 300°C.

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Abstract of the disclosure:

Process for the preparation of aminomethanephosphonic acid and aminomethylphosphinic acids

Aminomethanephosphonic acid and aminomethylphosphinic acids are interesting as biologically active compounds or as intermediates for the preparation of biologically active compounds. According to the invention, such compounds of the formula I



in which R^1 is OH, C_1 - C_4 -alkyl or phenyl, can be prepared in a technically simple manner by reacting compounds of the formula II



in which R^2 is H, C_1 - C_6 -alkyl, benzyl, phenyl, optionally substituted by C_1 - C_4 -alkyl, -alkoxy and/or halogen, and R^1 is as defined above, with water, at 80 to 300°C.

Description

Process for the preparation of aminomethanephosphonic acid and aminomethylphosphinic acids

5 Herbicidal and plant-growth-regulating actions are known
of aminomethanephosphonic acid; aminomethylphosphinic
acids are also industrially valuable compounds having a
biological activity or can be used as intermediates for
the preparation of biologically active compounds (see the
10 article by L. Maier "Advances in the Chemistry of Amino-
phosphinic Acids" in the periodical "Phosphorus and
Sulfur" 1983, Vol. 14, p. 295-322, in particular 317-323
and literature cited therein). Aminomethanephosphonic
acid is furthermore valuable as an intermediate for the
preparation of N-phosphonomethylglycine (see
15 EP-A-214,578).

Aminomethanephosphonic acid can be prepared from acyl-
aminomethanephosphonic acids by hydrolysis with hydro-
chloric acid (US-A-2,304,156; US-A-2,328,358; M. Soroka,
Synthesis 1989, 547). It is a disadvantage of this
20 process that the aminomethanephosphonic acid can only be
obtained in high yields during working-up when special
measures are applied. For example, M. Soroka describes
working-up with the aid of pyridine or propylene oxide,
which cause the separation of hydrogen chloride from the
25 aminomethanephosphonic acid. Another disadvantage is
that, without complicated ultrapurification, the acyl-
aminomethanephosphonic acids contain traces of formal-
dehyde, due to the production process. The treatment with
hydrochloric acid in the hydrolysis then results in the
30 formation of bischloromethyl ether as undesirable
by-product, which has been identified clearly as a
carcinogenic working substance. There is therefore a
demand for hydrolysis processes which can be carried out
on an industrial scale and which exclude the formation of
35 the by-product bischloromethyl ether.

The invention relates to a process for the preparation of compounds of the formula I



5 in which R^1 is hydroxyl, C_1 - C_4 -alkyl, preferably C_1 - C_2 -alkyl, in particular methyl, or is phenyl, which comprises reacting acylaminomethanephosphonic or acylaminomethylphosphinic acids of the formula II



10 in which R^2 is hydrogen, alkyl having 1 to 6 carbon atoms, preferably 1 to 3 carbon atoms, or is benzyl or phenyl, unsubstituted or substituted by one or more radicals from the group comprising C_1 - C_4 -alkyl, C_1 - C_4 -alkoxy and halogen, and R^1 is as defined above, with water, at 80 to 300°C, preferably 150 to 250°C.

15 Some of the starting substances of the formula II are known, or some are accessible analogously to known methods. For example, the acylaminomethanephosphonic acids of the formula II can be prepared from N-(hydroxymethyl)amides and PCl_3 (see US-A-2,328,358; US-A-2,304,156
20 or M. Soroka, Synthesis 1989, 547 and literature cited therein).

The acylaminomethanephosphonic acids as well as the acylaminomethylphosphinic acids of the formula II can also be prepared by the process in German Patent
25 Application P 4,026,026.7.

Examples of preferred starting substances of the

formula II are formylaminomethanephosphonic acid, acetylaminomethanephosphonic acid, benzoylamino-methanephosphonic acid, (acetylaminomethyl)(methyl)phosphinic acid and (benzoylamino-methyl)(phenyl)phosphinic acid.

5 The starting substances of the formula II are treated with water, if appropriate with an excess of water, and the mixture is brought to reaction temperature, and it may be necessary to carry out this process under pressure, as a function of the temperature.

10 The extent of the excess of water is not particularly critical for the reaction; for example, for reasons of better handling, it may be advantageous to use a 2 to 30 molar, preferably 10 to 25 molar, excess of water. The reaction temperatures are 80 to 300°C, preferably 150 to 250°C. The reaction times depend on the substrate, reaction temperature and pressure and are generally in the range from 5 to 40 hours, preferably 10 to 35 hours.

When the reaction is complete, working-up can be carried out in a simple manner, for example by removing the carboxylic acid as a solid (for example benzoic acid) or by distillation (for example acetic acid). The resulting aminomethanephosphonic acid, or aminomethylphosphinic acids, generally already have high purity. If appropriate, they can be obtained in ultrapure form by customary methods, preferably by crystallization.

Example 1

20 g (0.093 mol) of benzoylamino-methanephosphonic acid and 20 g of water were placed in a sealed tube and maintained at 200°C for 20 hours. After cooling, the reaction material was digested with 100 ml of water. The benzoic acid was subsequently filtered off with suction. The filtrate was concentrated in vacuo by distillation until it had reached an internal temperature of 75°C. There remained 10.3 g (100 % of theory) of aminomethane-

phosphonic acid which, according to ^{31}P -NMR spectrum analysis, had a purity of 95 %.

Example 2

5 20 g (0.093 mol) of benzoylaminomethanephosphonic acid and 20 g of water were placed in a sealed tube and maintained at 150°C for 20 hours. After cooling, the reaction material was then digested with methanol and filtered off with suction. 8.2 g (80 % of theory) of
10 aminomethanephosphonic acid of a decomposition point of 310°C were obtained.

Example 3

15 20 g (0.093 mol) of benzoylaminomethanephosphonic acid and 20 g of water were refluxed for 30 hours. After cooling, the reaction material was digested with 100 ml of methanol and filtered off with suction. 5.3 g (52 % of theory) of aminomethylphosphonic acid of a decomposition point of 275°C were obtained. Unreacted benzoylamino-methanephosphonic acid could be isolated from the filtrate.

20 Example 4

25 21.3 g (0.1 mol) of benzoylaminomethylmethylphosphinic acid and 42 g of water were placed in a sealed tube and maintained at 200°C for 20 hours. After cooling, the mixture was digested with water, and benzoic acid was removed by filtration with suction. The filtrate was evaporated to dryness in vacuo. The crystalline residue was digested with methanol and filtered off with suction. 8 g (73 % of theory) of aminomethylmethylphosphinic acid of a melting point of 255-261°C were obtained.

30 Examp1 5

20 g (0.073 mol) of benzoylaminomethylphosphinic

acid and 40 ml of water were placed in a sealed tube and maintained at 225°C for 23 hours. The benzoic acid was then removed by filtration with suction, followed by rinsing with water. The filtrate was concentrated to dryness in vacuo. There remained 12.5 g (100 % of theory) of crude aminomethylphenylphosphinic acid. After digestion with methanol, the substance obtained had a melting point of 276-278°C.

Example 6

10 14.4 g (0.094 mol) of acetylaminomethanephosphonic acid and 28 g of water were fed into a sealed tube and maintained at 200°C for 20 hours. The mixture was then cooled, and the resulting reaction solution was freed in vacuo from water and acetic acid. The residue was digested with a mixture of 30 ml of methanol and 1 ml of water. 15 9.6 g (92 % of theory) of aminomethanephosphonic acid of a decomposition point of 270-278°C were obtained.

Pat nt claims:

1. A process for the pr paration of compounds of th formula I



5 in which R^1 is hydroxyl, C_1 - C_4 -alkyl or phenyl, which comprises reacting acylaminomethanephosphonic or acylaminomethylphosphinic acids of the formula II



10 in which R^2 is hydrogen, alkyl having 1 to 6 carbon atoms, benzyl or phenyl, unsubstituted or substituted by one or more radicals from the group comprising C_1 - C_4 -alkyl, C_1 - C_4 -alkoxy and halogen, and R^1 is as defined above, with water, at 80 to 300°C.

15 2. The process as claimed in claim 1, in which R^1 is hydroxyl.

3. The process as claimed in claim 1, in which R^1 is methyl, ethyl or phenyl.

4. The process as claimed in claim 1, 2 or 3, in which R^2 is H, C_1 - C_3 -alkyl, benzyl or phenyl.

20 5. The process as claimed in claim 1, 2 or 3, in which R^2 is ph nyl.

6. Th proc ss as claimed in one or mor of claims 1 to 5, in which the r action temperatur is 150 to 250°C.

7. The process as claimed in one or more of claims 1 to 6, in which a 2 to 30 molar excess of water, based on 1 mol of compound of the formula II, is employed.

5 8. The process as claimed in one or more of claims 1 to 7, in which the reaction time is in the range from 5 to 40 hours.

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